



Acousto-Optic Deflector Driver

Including: Basic Deflector Alignment

Instruction Manual

RF2/RF3/RF5 Series – Digital/Analog/Dual Modulation

Key to model types: **RFn-fffT-p-m**

Base model features 1.0Vpp, 50ohm analog modulation input and 24/28Vdc supply.

'n' indicates amplitude modulation

2	:	Digital logic (On:Off)
3	:	Analog (Proportional control)
5	:	Dual (both above)

'fff' indicates centre frequency of tuning range

27	:	18-36 MHz
40	:	28-54 MHz
80	:	55-110 MHz
100	:	75-150 MHz
150	:	100-200MHz
200	:	145-260MHz
300	:	190-360MHz
350	:	220-500MHz

'p' indicates maximum output power

1	:	1Watt
2	:	2Watt
4	:	4Watt

and where appended,

'm' indicates options (combinations possible)

F	:	Heatsink with fan
R	:	Vertical mount foot
V	:	0-5V analog modulation
X	:	0-10V analog modulation

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1. GENERAL

The RFx series Modulator/Deflector Driver, figure 1, is a modular, swept-frequency RF power source specifically designed to operate with Isomet acousto-optic deflectors (scanners). The driver accepts a tuning voltage between approximately +0 volts and +10 volts and provides an RF output to the acousto-optic deflector at the tuned frequency. The driver also accepts amplitude modulation signal(s). Examples of popular driver specifications are listed below:

<u>Model</u>	<u>Application</u>
RF5-80T-4	: 60-100MHz, 4W output, Dual modulation, +24Vdc supply
RF2-200T-2	: 150-250MHz, 2W output, 5V logic Digital, +24Vdc supply
RF3-350T-1	: 250-450MHz, 0.7W output, 1.0V Analog Modulation, +24Vdc supply

A block diagram of the driver is shown in Figure 2. The output frequency of the driver is controlled by a hybridized varactor oscillator circuit. The capacitance of the internal varactor is a function of the applied tuning voltage. The output frequency is proportional to the input tuning voltage with a scale factor of approximately 4 to 10.0 MHz/volt. The start frequency corresponding to a tuning voltage of 0.0 volts is defined by the frequency offset potentiometer (FOS). This permits adjustment of the start frequency from approx -10% / +50%. A table of output frequency versus input tuning voltage is supplied with each driver; a typical voltage vs. frequency curve is shown in figure 4. The frequency linearity is typically $\pm 2\%$, and frequency stability is typically $\pm 0.25\%$.

The oscillator output is connected to a matched RF splitter. This provides buffered signals to a diode ring RF modulator and the frequency monitor output. The frequency monitor output provides a low level (approx. 300mVpp) output signal at the tuned operating frequency. This can be used for measurement or feedback purposes.

The high-frequency, diode ring modulator in combination with a high-speed semiconductor RF switch are used to amplitude-modulate the RF carrier.

D-Mod : A 5V logic input swing from < 1.0V (off) to > 3.5 volt(on) will result in 100% depth of modulation. **The modulation input level must not exceed + 7 volts**

A-Mod : For the standard model, an input swing of 1 volt peak positive or 1 volt negative will result in 100% depth of amplitude modulation. **The video input level must not exceed ± 2 volts** (or less than 2x the A-Mod specified input voltage).

Active modulation	Model	Signal Input	ON-OFF ratio
Digital (DMOD)	RF2 -	5V logic compatible	>37dBc
Analog (AMOD)	RF3 -	0 - 1V *, 50ohm	>37dBc
Dual	RF5 -	Both the above (SMB #2 fitted)	>48dBc

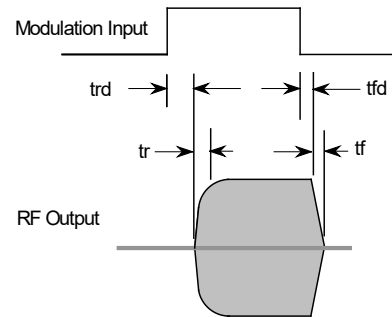
The input levels must not exceed 2x the specification value.

(Note: For the -V and -X options, the respective Analog input levels are 5 volt and 10 volt)

Either input *D-Mod* = Logic Low or *A-Mod* = 0V with turn the RF off.

Typical switching and latency timing for 200MHz driver

Active Input	trd	tfd	tr	Tf
D-Mod	20ns	20ns	6ns	6ns
A-Mod	20ns	20ns	16ns	14ns



Both modulation inputs are required for the RF5 dual modulation option.

The output Class A amplifier is designed to operate at full rated power into a 50Ω load with 100% duty cycle. The output power level is set by the power adjust potentiometer

Figure 3 illustrates the principal waveforms

Conduction cooling of the driver from the mounting face to a heat sink or forced-air convection cooling is mandatory. The mounting face temperature must not exceed 70°C.

SERIOUS DAMAGE TO THE AMPLIFIER MAY RESULT IF THE TEMPERATURE EXCEEDS 70°C. SERIOUS DAMAGE TO THE AMPLIFIER MAY ALSO RESULT IF THE RF OUTPUT CONNECTOR IS OPERATED OPEN-CIRCUITED OR SHORT-CIRCUITED.

All drivers require a stable d-c power for operation. The required voltage is +24Vdc (+28Vdc maximum) at a current drain of approximately 550mA. The external power source should be regulated to $\pm 2\%$ and the power supply ripple voltage should be less than 100mV for best results.

2. SAMPLE SPECIFICATIONS

Oscillator Type:	Varactor-tuned thin film hybrid
Amplifier Type:	Broadband Class A
Output RF Power:	$\geq 1/2/4$ Watt (See specific driver test data sheet)
Output Impedance:	50 Ω nominal
Load VSWR:	< 2.5:1 for best results
Output RF Power Variation vs. Frequency	≤ 1 dB
Spurious Outputs:	Harmonics > 20dB below fundamental
Tuning Range:	Model specific
Tuning Voltage:	0 to 10V for specified tuning range
Tuning Linearity:	< +/- 2% over specified tuning range
DO NOT APPLY NEGATIVE TUNING VOLTAGE DO NOT EXCEED + 20V INPUT DAMAGE MAY RESULT	
Tuning Voltage Impedance:	Drive from low impedance source, 50 Ω or less
Tuning Slew Rate	From 3MHz/ μ s to 10MHz/ μ s, model dependent
Residual FM:	< 10 KHz peak-to-peak
Frequency Stability:	$\pm 0.25\%$
Analog Modulation Voltage:	1V (5V/10V options) peak-to-peak for 100% depth of modulation, DC coupled
Mod Input Impedance:	50 Ω source
RF ON-OFF Ratio:	Single modulation >37dBc. Dual modulation >48dBc
DC Power Input:	+24VDC at < 600 mA regulated to $\pm 1\%$
Temperature Range:	0°C to 60°C ambient, temperature at mounting face must not exceed 70°C
Mounting Orientation:	Any. Foot for vertical mounting supplied as an option

3. THEORY OF OPERATION

Figure 5 illustrates the key operating parameters. Further explanation is given in the accompanying application note AN4820 Acousto Optic Deflectors.

4. INSTALLATION AND ADJUSTMENT

- a. Install the Driver on a heat sink. Use heat conducting compound between the Driver mounting face and the heat sink.
- b. With no d-c power applied, connect the + 24Vdc line to the centre terminal of the feed-thru terminal as shown in Figure 1. DO NOT APPLY POWER UNTIL THE LOAD IS CONNECTED.
- c. Align the deflector head to ensure that the incident light beam is centred in the active aperture of the deflector. The following explanation assumes the light beam is directed slightly toward the transducer (connector end) of the deflector. [Note: Off-axis AO deflectors e.g.model type "OAD" are designed to operate in a specific orientation. See data sheet for guidance]
- d. Connect the SMA connector of the deflector to the SMA 'RF' output of the driver.
- e. Connect a source to the SMB modulation input(s) 'MOD' and adjust to give a constant ON level. Refer to model data sheet for levels.
- f. Connect the tuning voltage source to the SMB tuning voltage input 'TUNE' (or 'Vt').
To begin, apply a constant voltage of 5V equivalent to the centre frequency.

The start point of the input tuning voltage can be adjusted by means of a 10-turn 'FOS' adjustment potentiometer NOTE: Counter-clockwise rotation of the FOS pot' increases the start frequency.

The output frequency can be measured by connecting a frequency counter to the 'Fmon' output SMB connector.

- g. Start by rotating the Power Adjust potentiometer by fully anti-clockwise. This will give minimum output. The RF power increases with clockwise rotation of the pot. This is a 4-turn pot.
- h. Apply approximately half the required RF power (say 0.3 - 0.4W) at the centre frequency. Typically, this is achieved by adjusting the 1 turn clockwise from the fully counter-clockwise position. Turn on DC power.

Rotate the deflector slightly until deflection of the light beam occurs. The deflection will occur in the horizontal plane. Select the diffraction spot next to the undiffracted beam and monitor the light intensity by using either a photodetector or a light power meter. Re-adjust the Bragg angle for maximum deflected light intensity. Fine tuning of the incident light beam position may be necessary for optimum results.

- i. Adjust RF power level carefully for the desired efficiency at the minimum RF power necessary. Do NOT exceed the RF power level at which maximum efficiency is achieved (P_{sat}). Over driving the AO deflector will reduce efficiency and may result in serious damage to the AO crystal.
- j. To equalise deflection efficiency at the extremes of the scan, alternate between the minimum and maximum desired frequencies and adjust Bragg angle to give the same efficiency for both. (Note: the photo detector or light power meter will require repositioning for the two angles).
- k. Under some circumstances, the RF driver maximum output power will be less than the AO device optimum operating point e.g. at longer NIR wavelengths. In such cases, the diffraction efficiency roll-over point will not be observed as the RF power is increased.

WARNING

**Take care not to exceed the maximum average RF power rating for the connected AO device.
Refer to AO test data sheet**

5. THERMAL EFFECTS

We must consider the thermal effects of this device - both due to optical and acoustic absorption.

The majority of heat is generated by RF drive power. As the temperature of the material increases beyond the recommended level, undesired refractive index changes will occur in the material. This results in beam distortion. Ultimately, the crystal will crack due to thermal stresses, if excessive RF power is applied. (>2.0W for a typical visible AO deflector).

6. MAINTENANCE

6.1 Cleaning

It is of utmost importance that the optical apertures of the deflector optical head be kept clean and free of contamination. When the device is not in use, the apertures may be protected by a covering of masking tape. When in use, frequently clean the apertures with a pressurized jet of filtered, dry air.

It will probably be necessary in time to wipe the coated window surfaces of atmospherically deposited films. Although the coatings are hard and durable, care must be taken to avoid gouging of the surface and residue of the cleaning solution. It is suggested that the coatings be wiped with a soft ball of brushed (short fibres removed) cotton, slightly moistened with clean alcohol. Before the alcohol has had time to dry on the surface, wipe again with dry cotton in a smooth, continuous stroke. Examine the surface for residue and, if necessary, repeat the cleaning.

6.2 Troubleshooting

No troubleshooting procedures are proposed other than a check of alignment and operating procedure. If difficulties arise, take note of the symptoms and contact the manufacturer.

6.3 Repairs

In the event of deflector malfunction, discontinue operation and immediately contact the manufacturer or his representative. Due to the high sensitive of tuning procedures and the possible damage which may result, no user repairs are allowed. Evidence that an attempt has been made to open the optical head will void the manufacturer's warranty

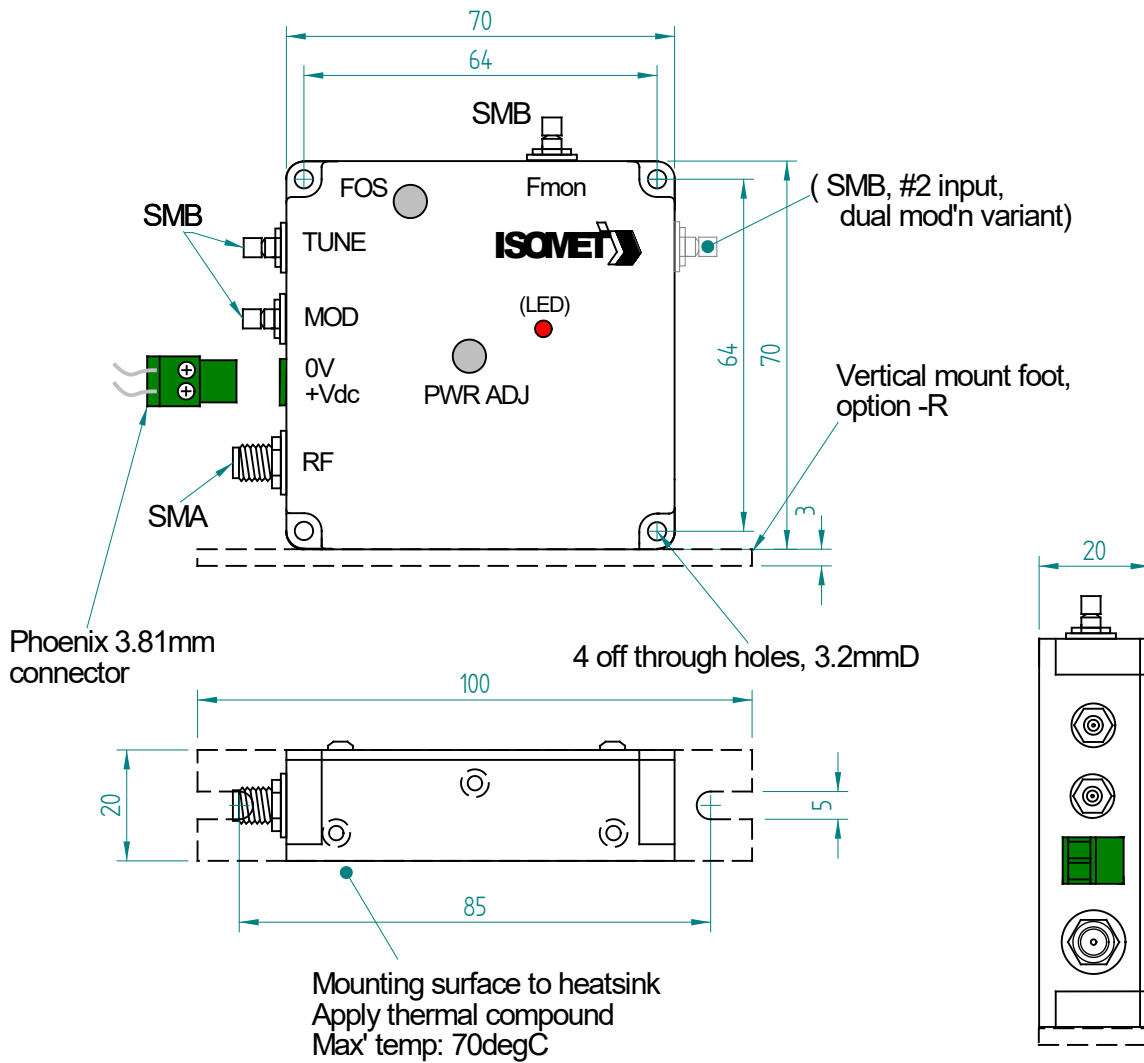


Figure 1, Driver Installation

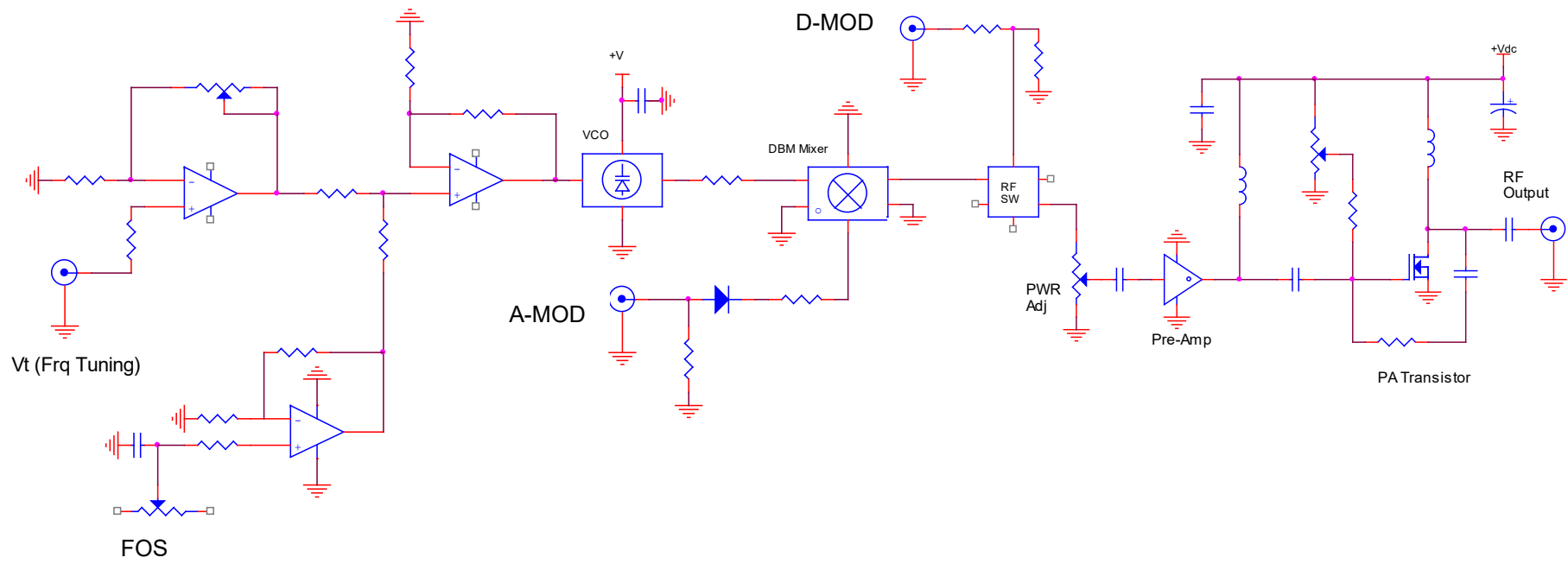


Figure 2, Driver Block Diagram

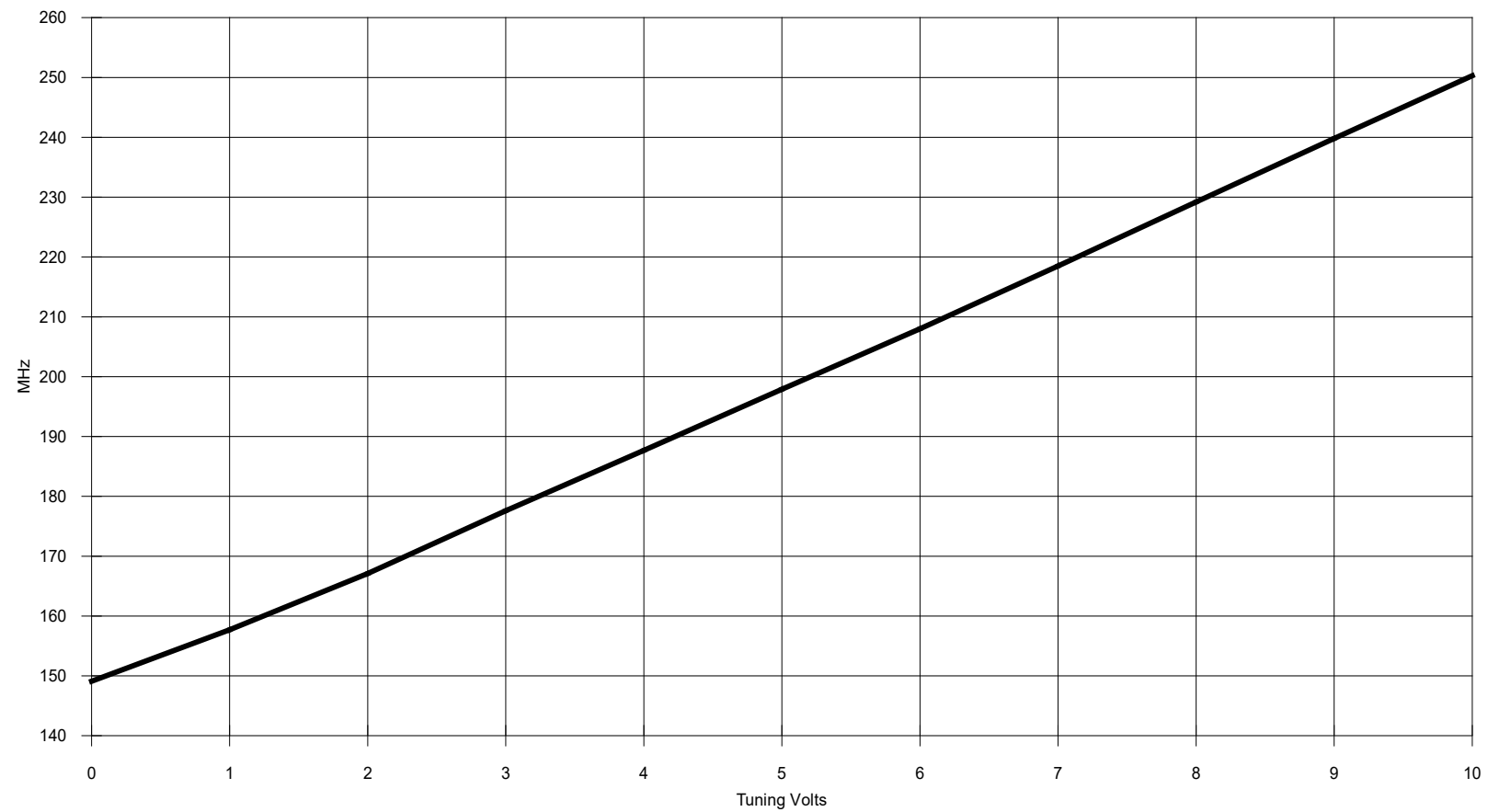
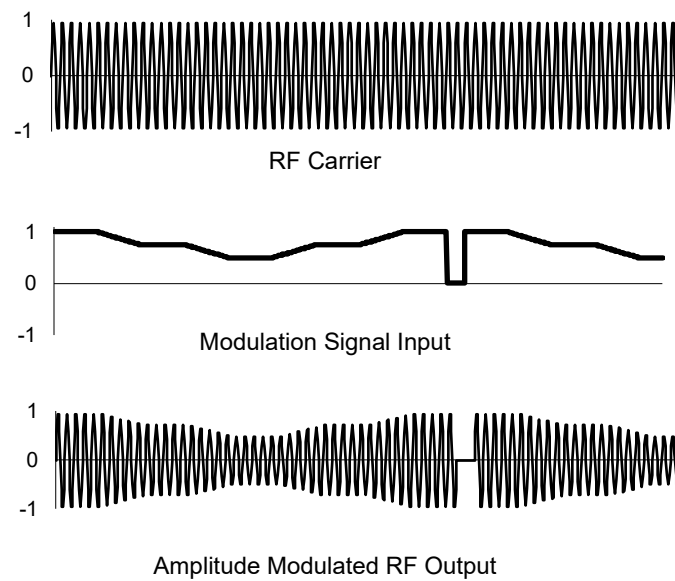


Figure 4, Typical Tuning Characteristic for RF(x)-200T

RF3- Analog only modulation function shown above.
 (or a Dual mod RF5- driver with D-Mod = constant 5V / Logic high)



For the Dual modulation RF5- driver, the output modulation is a combination of BOTH analog and digital controls as illustrated below.

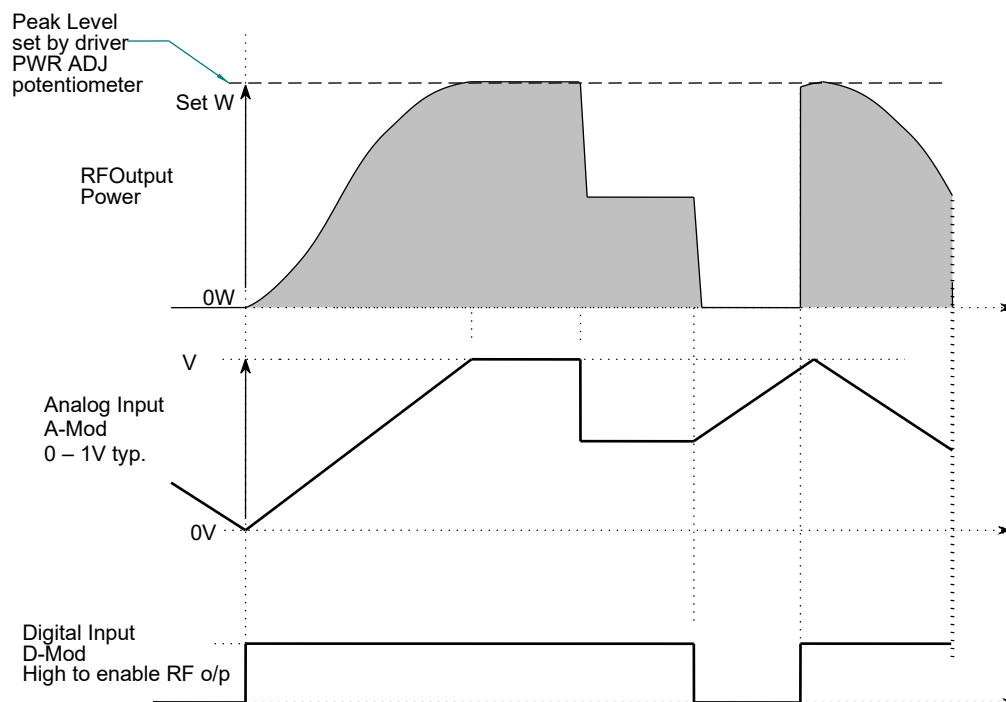
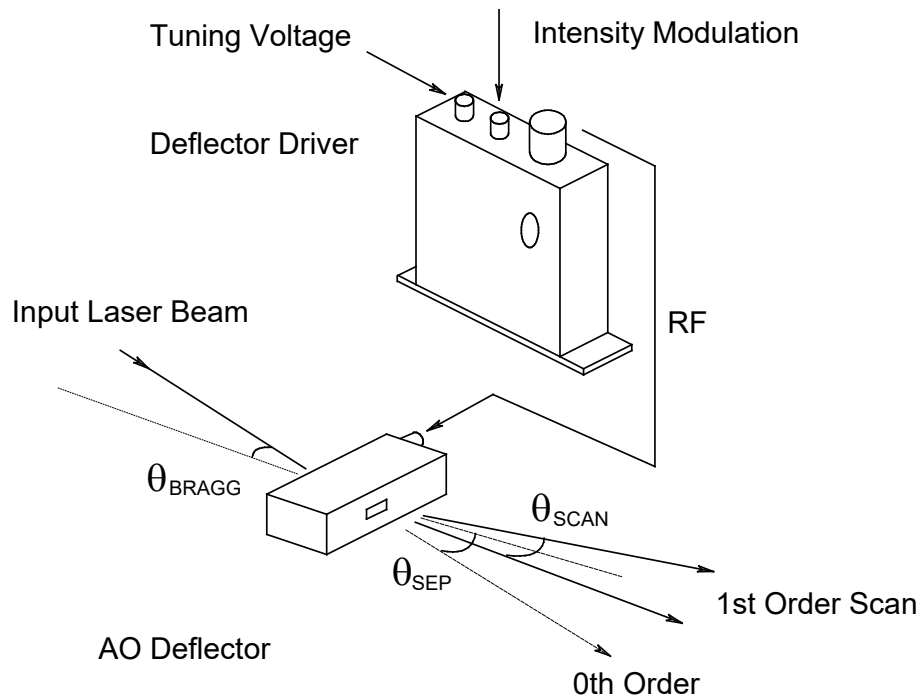


Figure 3: Typical Modulation Waveforms

Schematic of a single electrode acousto optic deflector and tunable driver



The input Bragg angle, relative to a normal to the optical surface and in the plane of deflection is:

$$\theta_{BRAGG} = \frac{\lambda \cdot fc}{2 \cdot v}$$

The separation angle between the zeroth order and mid scan point of the first order is :

$$\theta_{SEP} = \frac{\lambda \cdot fc}{v}$$

The first order scan angle is:

$$\theta_{SCAN} = \frac{\lambda \cdot \delta f}{v}$$

where:

λ	=	wavelength
δf	=	scan frequency bandwidth
fc	=	centre frequency
v	=	acoustic velocity of interaction material

cont'd

Figure 5,

Diagram shows typical beam alignment..

Laser can be input either side of AOM.

Orientation options

